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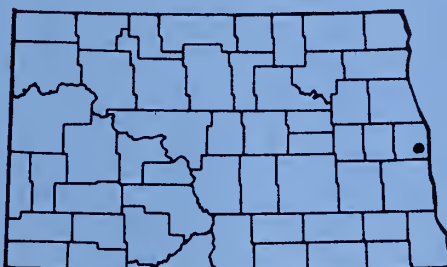
FLOOD HAZARD ANALYSES

CITY OF HILLSBORO

AND VICINITY

TRAILL COUNTY, NORTH DAKOTA

NORTH DAKOTA



Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Bismarck, North Dakota
In cooperation with the
CITY OF HILLSBORO
and the
NORTH DAKOTA STATE WATER COMMISSION

NOVEMBER 1973



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CITY OF HILLSBORO
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United States Department of Agriculture
U.S. Soil Conservation Service /
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In cooperation with the

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✓ North Dakota State Water Commission

November 1973



HILLSBORO FLOOD HAZARD ANALYSES

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FOREWORD

This Flood Hazard Analyses Report delineates areas subject to flooding by the Goose River within and adjacent to the city of Hillsboro, North Dakota.

This cooperative study was requested by the city of Hillsboro through the North Dakota State Water Commission, in accordance with the Commission's October 1972 Joint Coordination Agreement with the Soil Conservation Service.

The study was carried out according to the Plan of Study developed by the State Water Commission, the city, the East Traill Soil Conservation District, and the Soil Conservation Service.

This report is to serve as a technical tool to aid in regulating the land use and development of flood-prone areas within the corporate limit and as a guide for future development of annexed land outside the corporate limit.

The Soil Conservation Service and the North Dakota State Water Commission will provide interpretation and technical assistance in the application of the flood hazard data presented in this report.

INTRODUCTION

The purpose of this study was to identify existing flood hazards within and adjacent to Hillsboro so that future planning of annexed land within the flood plain may be controlled to its proper land use.

This flood hazard study was requested by the city of Hillsboro through the North Dakota State Water Commission, under the Joint Coordination Agreement signed with the Soil Conservation Service, U. S. Department of Agriculture, in October 1972. The Soil Conservation Service carries out flood hazard studies under the authority of Section 6 of Public Law 83-566, in response to Recommendation 9(c), "Regulation of Land Use," of House Document No. 465, 89th Congress, 2nd Session, and in compliance with Executive Order 11296, dated August 10, 1966. Priorities regarding such studies are set by the North Dakota State Water Commission.

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Knowledge of flood hazards is not widespread and consequently the managers, potential users, and occupants cannot always accurately assess the risks. In order for flood plain management to effectively play its role in the planning, development, and use of flood plains, it is necessary to:

1. Assist State and local units of government in preparing appropriate technical information and interpretations for use in flood plain management.
2. Provide technical services to managers of flood plain property for community, industrial, and agricultural uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and groups.

This report contains aerial photomosaic maps, high water profiles, and typical valley cross sections indicating the extent of flooding which can occur from the Goose River. Three separate floods are outlined, the 50-, 100-, and 500-year frequency events.

This report does not contain recommendations for the solution of local flood problems, such as dikes and levees and channel work. It is intended to provide a technical basis for minimizing flood damages through a local flood plain management program.

The North Dakota State Water Commission and the Soil Conservation Service will, upon request, provide technical assistance to Federal, State, and local agencies and organizations in the interpretation and use of the information developed in this study.

DESCRIPTION OF THE STUDY AREA

Study Area Limits

The area studied within the corporate limit of Hillsboro, North Dakota, is within the jurisdictional limits of the city for the application of zoning and subdivision regulations containing flood plain management provisions.

The area outside the corporate limit is outside the jurisdictional limits of the city for the application of zoning and subdivision regulations containing flood plain management provisions. This area was included in

the study so that prior planning can be made for future annexation.

The limits of the study area are shown on the index map.

The Community

Hillsboro, present population of 1,309 people, is predominantly a farm community. Most of the people are employed directly with agriculture and agricultural related enterprises.

Hillsboro is partially a "satellite" community, as a small portion of the labor force is employed outside of the community, in Fargo and Grand Forks, but maintain their residences in Hillsboro. Hillsboro is within commuting distance from Fargo (40 miles) and Grand Forks (35 miles).

The area of incorporation, at present, is approximately one square mile. The present platted area is about 70 blocks (about 350 acres). The remaining unplatted area is being used for agricultural purposes.

Currently, the community is experiencing significant economic expansion. A farm cooperative is building a new sugar beet processing plant which will begin production soon and will employ several hundred people. A new cafe, two gas stations, and a new motel were recently opened as a result of the Interstate Highway which bypasses the city on the west side.

Watershed and Stream Characteristics

The Goose River has a total drainage area of approximately 1,203 square miles above Hillsboro. Approximately 110 square miles of this are noncontributing (pothole area).

The Goose River and its numerous tributaries rise in the glaciated uplands of Nelson, Grand Forks, and Steele Counties, North Dakota. These tributaries flow in an easterly direction and join the Goose River in the vicinity of Portland, North Dakota. The Goose River joins the Red River of the North about nine miles east of Hillsboro (26.87 river miles).

The western portion of the watershed is covered by gently rolling glacial ground moraine and intermittent potholes. East of the moraine area the channels flow through and across the flat, featureless Elk Valley Delta which was deposited in former glacial Lake Agassiz. The eastern portion of the watershed is characterized by a broad, flat lacustrine plain. Low swells of former beach lines break up the otherwise low, monotonous relief.

Climate

Located in the northern plains, Hillsboro has a climate that is continental in its characteristics. The frequent passage of weather systems across the area brings a wide variety of weather in all seasons and wide variations in temperatures from day to day and month to month. Summers are warm and pleasant with sunny days and cool nights. Maximum temperatures during the three summer months of June, July, and August average 81 degrees. Temperatures of 90 degrees or more occur on an average of 17 days per year ranging from 3 in the coolest summers to 46 in 1936. Temperatures in the winter months of December, January, and February average about 10 degrees but maximum temperatures reach 32 degrees or higher on 17 days during these months, and drop to zero or below on an average of 54 days each year.

The average annual precipitation at Hillsboro is 20.19 inches, of which about 75 percent falls in the growing season, April through September, and about 45 percent falls in the months of May, June, and July. Annual precipitation has ranged from over 31 inches in 1916 to about 7 inches in 1936. Summertime precipitation is usually in the form of thundershowers, about 30 thunderstorms are reported each year. June is usually the wettest month of the year but July 1952, when 12.29 inches of precipitation was measured, is the wettest month on record. Precipitation of .10 inch or more can be expected on an average of 44 days per year and rainfall of 1.00 inch or more per day occurs about twice a year. The likelihood of 1.00 inch or more of rain in a 7-day period is greatest the first part of June when the chance is about once in three years. The likelihood of a dry 7-day period, trace or less, is greatest the first week in November when the chance is one year in two. Intensities of about 1.10 inches in 1 hour, 1.75 inches in 6 hours, and 2.25 inches in 24 hours, can be expected once in two years. About 32 inches of snow can be expected each year in Hillsboro, but snowfall has varied from 4.0 inches in 1957-58 to about 74 inches in 1947-48. The greatest snowfall measured in any month is 26.5 inches in March 1913. The greatest one-day snowfall is 10.5 inches on November 15, 1947. Measureable snow can be expected one year in ten in October, one year in two in April, and one year in seven in May.

Historical Floods

Flooding occurs to portions of Hillsboro on the average of once every five years. The large floods occur from spring snowmelt runoff due to

winter accumulations of snow and frozen soil conditions. There is no historical documentation of large floods occurring from excess rainfall.

Floods in recent years occurred in April of 1969, April of 1965, April of 1950, and April of 1948. Floods of earlier years occurred in April of 1882, April of 1897, and April of 1916. During these floods, streets and roads within the flooded area are generally impassable for a period of approximately 10 days. Due to the foresight of city officials, a part of the area subject to flooding was designated as a city park. Only a limited number of private buildings exist in the remaining flood plain. This has kept dollar damages to a minimum.

Within Hillsboro, minor flood flows in the river are retarded somewhat by a low dam (Foogman Dam) located just north of the city (at river mile 27.73). This dam was built in the 1930's to provide a water supply for the city of Hillsboro. It was reconstructed in 1951, repaired in 1956, and gunnited in 1963.

There are approximately 642 acres within the corporate limit. A 50-year frequency flood will inundate approximately 53 acres (8.2 percent of the total); a 100-year flood will inundate approximately 56 acres (8.7 percent of the total); and a 500-year flood will inundate approximately 58 acres (9.0 percent of the total).

TECHNICAL STUDY PROCEDURES

USGS streamgage, Goose River at Hillsboro (No. 05-066500), with 40 years of record, provided the necessary peak-frequency-stage data. Water

surface profiles for the 50-, 100-, and 500-year frequency floods were based on the April 1950 snowmelt flood, for which adequate data were available. The 100-year frequency flood discharge used is the same as that used by the St. Paul District, U. S. Army Corps of Engineers.

The areas subject to inundation by the 50-, 100-, and 500-year frequency floods are shown on the August 1971 aerial photomosaics. The water surface elevation lines for the 100-year flood shown on the mosaics are intended to serve as a guide for city planners and builders. While most of these elevation lines are at even foot elevations, any location in between the lines can be interpolated by using the water surface profiles.

Elevation-Frequency Curve

An elevation-frequency curve (Figure 3) was developed for the river at the Burlington Northern Railroad crossing. This curve is typical of the entire reach within the corporate limit.

FLOOD PLAIN MANAGEMENT

With technical flood hazard information available, the city has a valuable tool to minimize future flood losses by planning for the protection, wise use and orderly development of its flood plains. The overall plans of the community for industrial, commercial, and residential areas, for streets and utilities, and for parks and schools, can be coordinated with the need to temporarily store and convey floodwaters.

A planning procedure such as this is an integral part of a comprehensive flood plain management program. Effective flood plain management involves

the full range of public policy and action for insuring wise use of the flood plains. It includes everything from collection and dissemination of flood control information to acquisition of flood plain lands, construction of control measures, and enactment and administration of codes, ordinances, and statutes regarding flood plain land use and development.

A flood plain management program is comprised of numerous elements (See Figure 1 and Figure 2). Some of these are: structural flood control works to protect existing development; regulations to guide new development; flood insurance to protect existing and new buildings; and individual adjustment measures, including flood proofing.

Flood Control Measures

Various flood control measures are available including floodwater retarding structures, levees, floodways and channel work, or a combination of these.

Flood Plain Regulations

Flood plain regulations are designed to permit realistic use of flood plain areas without materially increasing the flood damage potential. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary and utility regulations.

Flood plain management practices are necessary tools to protect human life and health and minimize property damages and economic losses. Local units of government should adopt flood plain regulations as soon as sufficient data are available to determine the floodway areas required along the river and side tributaries.

The basic purpose of flood plain regulations is to regulate development on the flood plain consistent with nature's needs for the conveyance of flood flows and the community's land use and development objectives.

Flood Insurance

Under the National Flood Insurance Act of 1968, the Department of Housing and Urban Development (HUD) is authorized to carry out a National Flood Insurance Program which makes flood insurance available for losses due to inundation by floodwaters. Coverage is available for all structures used for residential, business, religious and agricultural purposes, buildings occupied by nonprofit organizations, and those owned by State or local governments or their agencies. Coverage is also available for the contents of these buildings.

Insurance is sold to individual property owners only after the community applies to HUD and warrants it has adopted land use and control measures for flood hazard areas consistent with criteria set forth in HUD regulations.

Further inquiries about the flood insurance program should be directed to the North Dakota State Water Commission, the official State coordinating agency.

Other Measures

Land use controls such as zoning, subdivision regulations and building codes can play an important role in flood plain management. However, in order for these measures to be effective, it is important that the community take action to implement other programs and measures to supplement these

controls. A few possible measures are (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures, and (5) public policy governing the construction of public facilities such as bridges and streets compatible with the flood potential and to locate such facilities in a manner to discourage development in flood-prone areas.

The North Dakota State Water Commission, upon request, will provide assistance to the community in such areas as flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

TABLE 1
DISCHARGE-FREQUENCY DATA
FOR GOOSE RIVER
HILLSBORO, NORTH DAKOTA

Location	Goose River - Existing Conditions*					
	500-Year Frequency		100-Year Frequency		50-Year Frequency	
	Estimated : Discharge : (cfs)	Elevation : (msl)	Estimated : Discharge : (cfs)	Elevation : (msl)	Estimated : Discharge : (cfs)	Elevation : (msl)
West study limit - I-29, Sec. 6, T 145N, R 50W (River mile 29.97) <u>1/</u>	26,000	900.5	15,000	899.3	11,000	898.3
Burlington Northern Railroad bridge (River mile 28.92) <u>1/</u>	26,000	898.8	15,000	897.6	11,000	896.6
East study limit - East side of Sec. 32, T 146N, R 50W (River Mile 26.87) <u>1/</u>	26,000	895.7	15,000	894.5	11,000	893.5

* Discharge assumed constant for each frequency at each location because of only minor changes.

1/ River mile 0.00 is at the confluence of the Goose River with the Red River of the North.

TABLE 2
PEAK DISCHARGE AND DATES
OF SELECTED FLOODS
ON THE
GOOSE RIVER AT
HILLSBORO, NORTH DAKOTA

<u>Date of Crest</u>		<u>Estimated Peak</u>
<u>Year</u>	<u>Month</u>	<u>Discharge (cfs)</u>
1970	April	3040
*1969	April	7640
1966	March	3290
1965	April	6800
1950	April	9420
1948	April	4180
1943	March	3480

* Approximately a 25-year frequency flood event (highest recorded peak discharge since 1950).

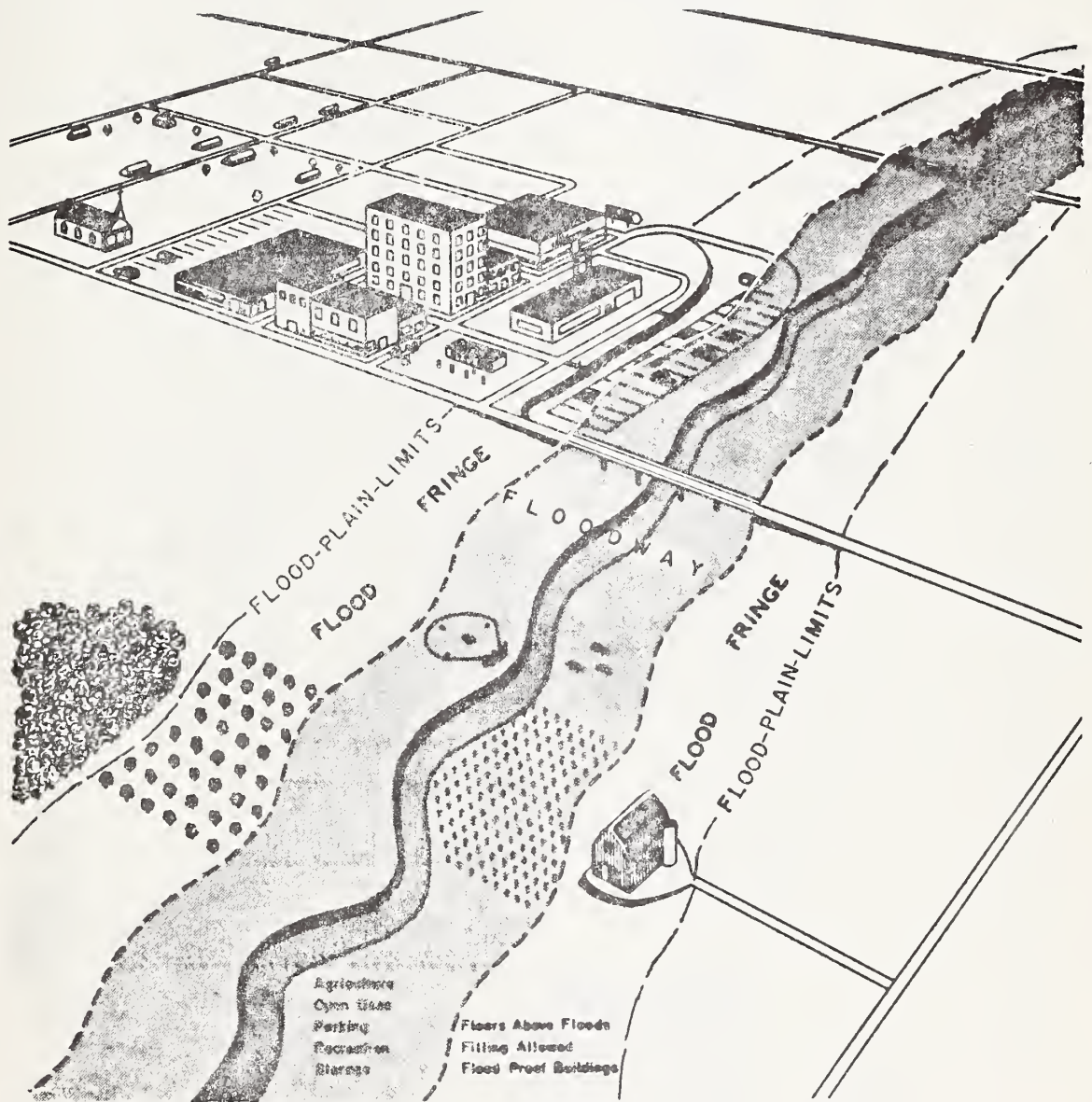


Figure 1. Perspective view of a typical regulatory flood plain

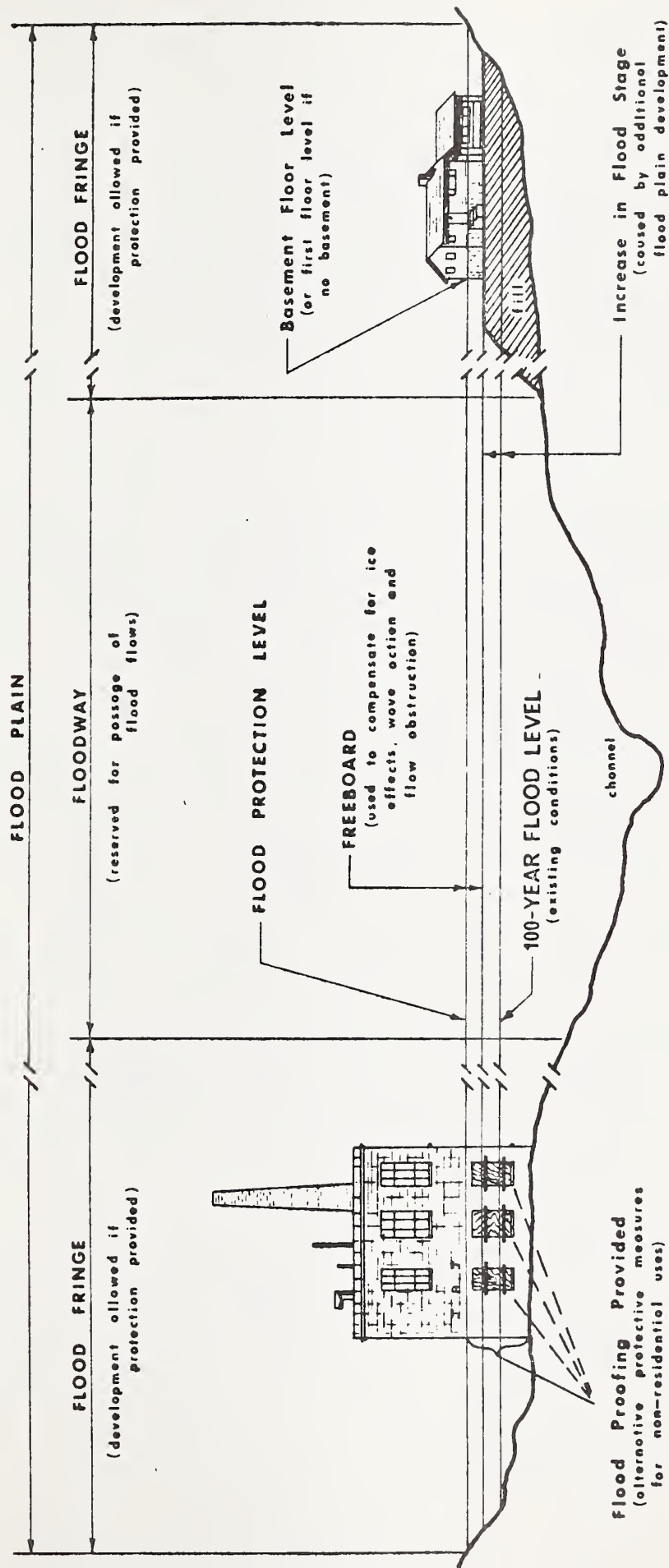


Figure 2. Cross sectional view of a typical regulatory flood plain

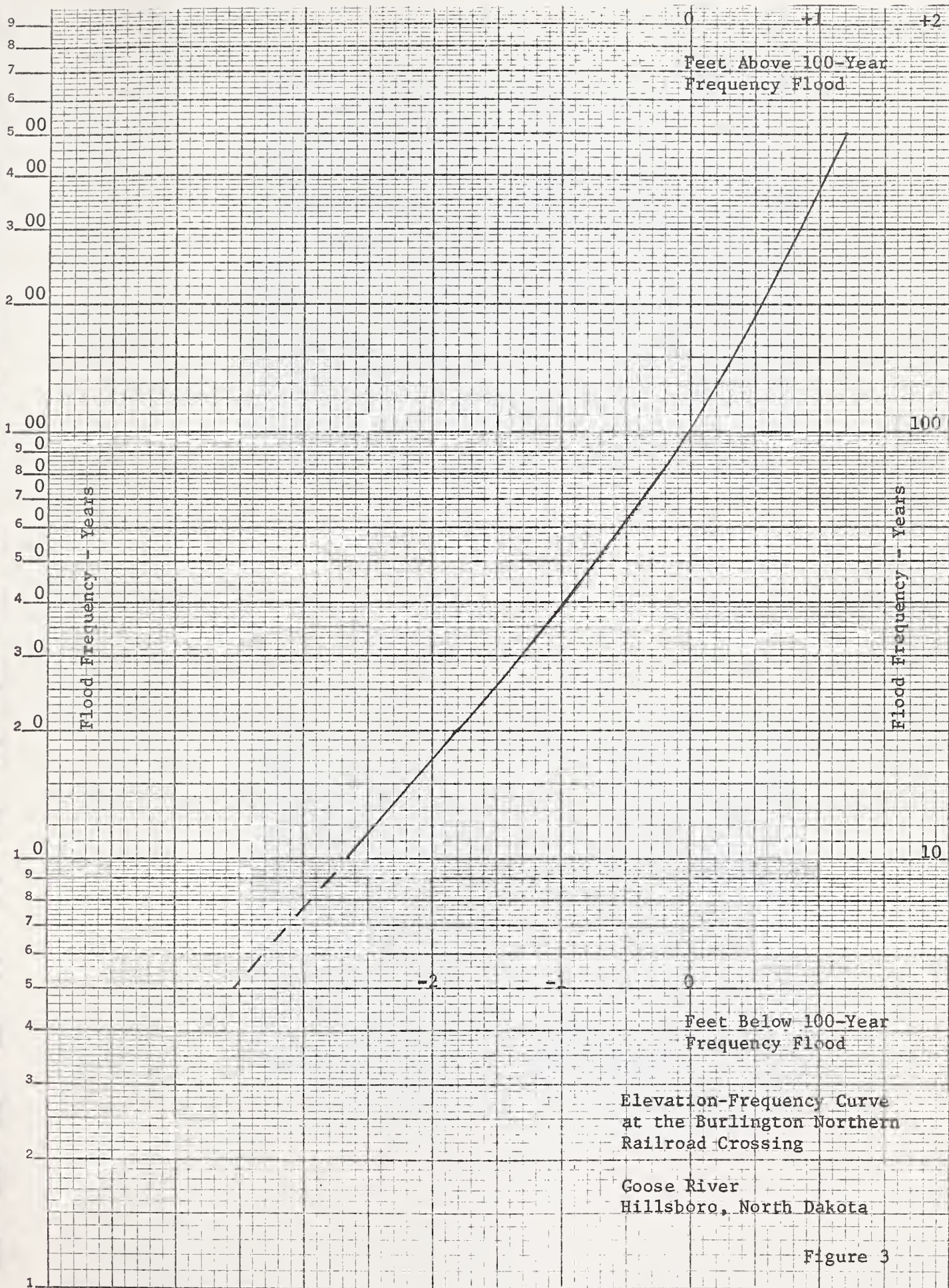




FIGURE 4

AN APPROXIMATE 20-YEAR FREQUENCY SNOWMELT FLOOD OVER
THIRD STREET BRIDGE, HILLSBORO, NORTH DAKOTA (APRIL 1965).



FIGURE 5

AN APPROXIMATE 20-YEAR FREQUENCY FLOOD IN THE HILLSBORO
PARK AREA CAUSED BY SNOWMELT ON FROZEN GROUND (APRIL 1965).



FIGURE 6

NORTH DAKOTA HIGHWAY 81 BRIDGE AT GOOSE RIVER - NORTH OF HILLSBORO, NORTH DAKOTA.



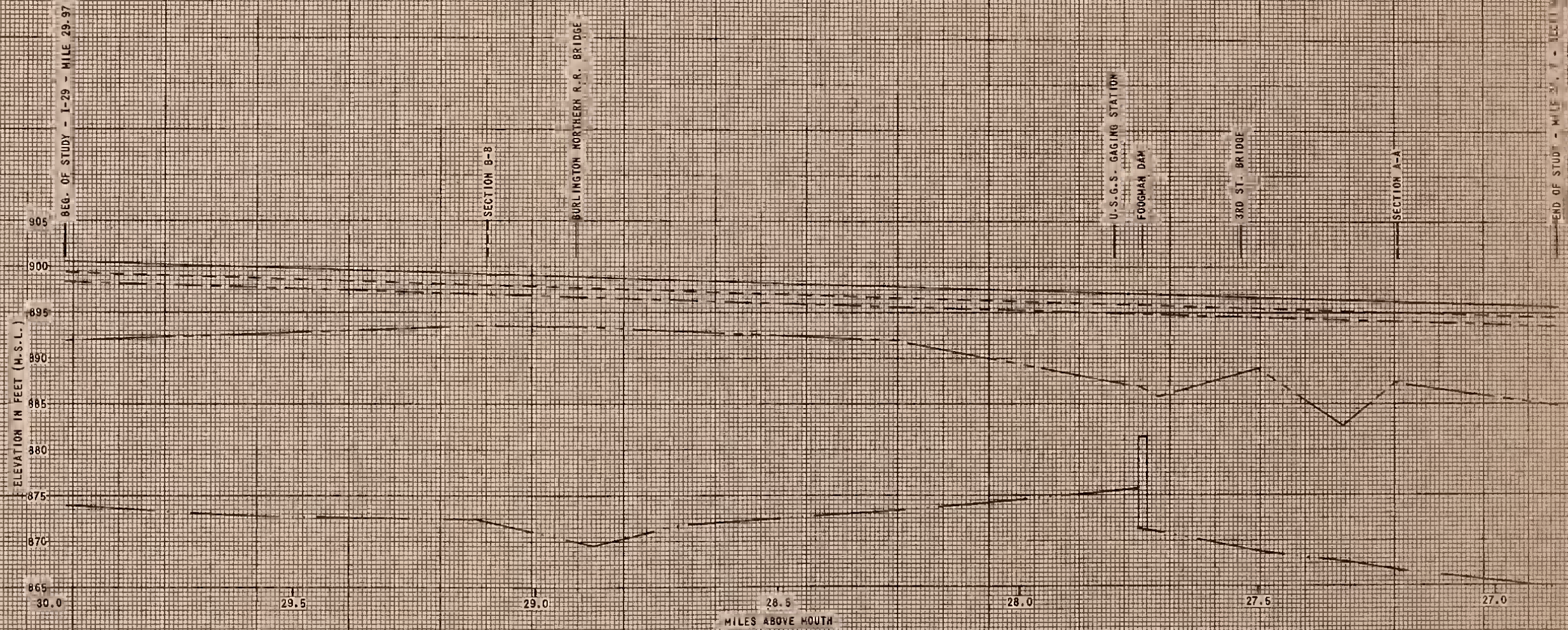
FIGURE 7

BRIDGE AT THIRD STREET, OVER GOOSE RIVER AT HILLSBORO, NORTH DAKOTA.



FIGURE 8

SWIMMING POOL AT HILLSBORO, NORTH DAKOTA.

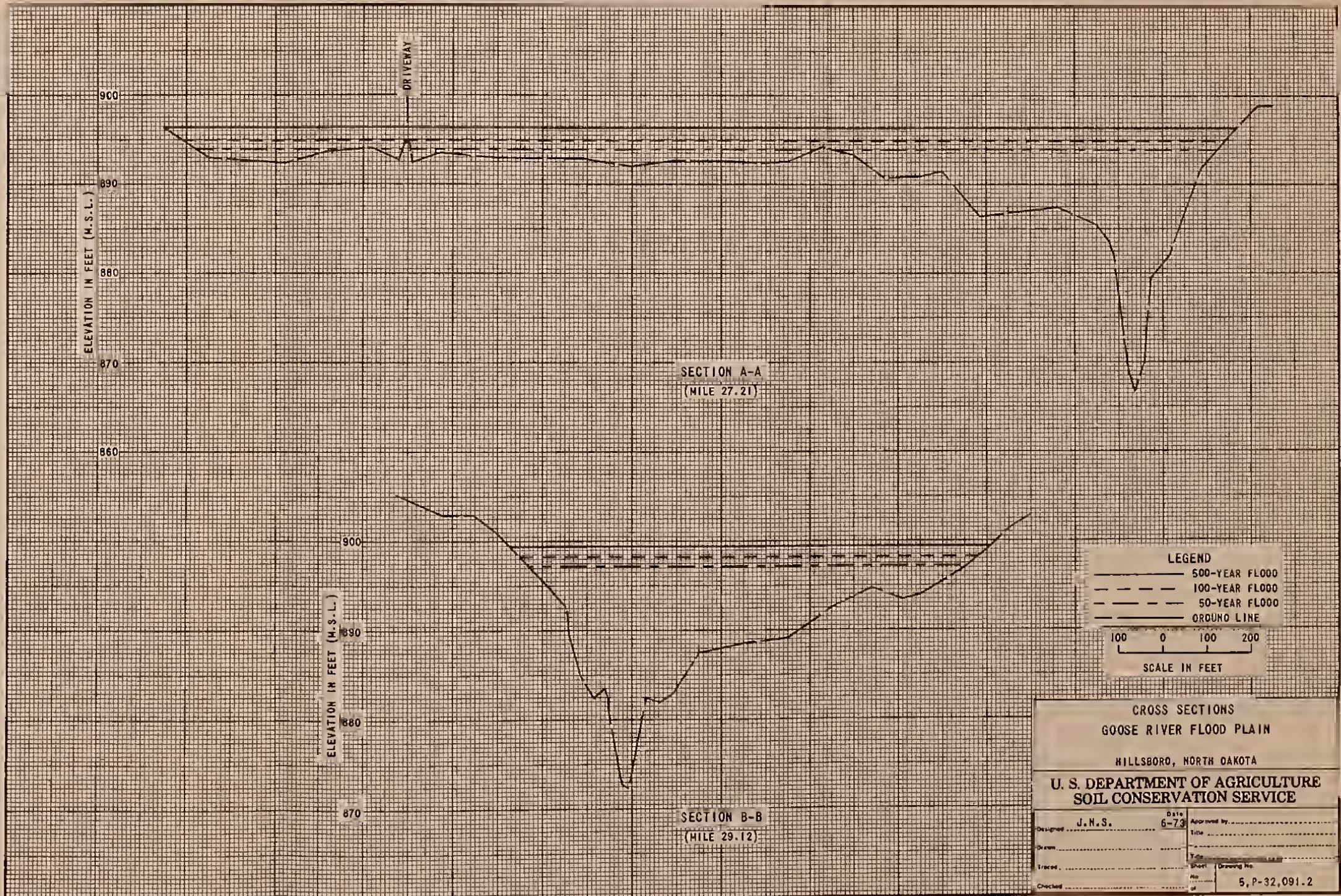


RIVER PROFILES GOOSE RIVER

HILLSBORO, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

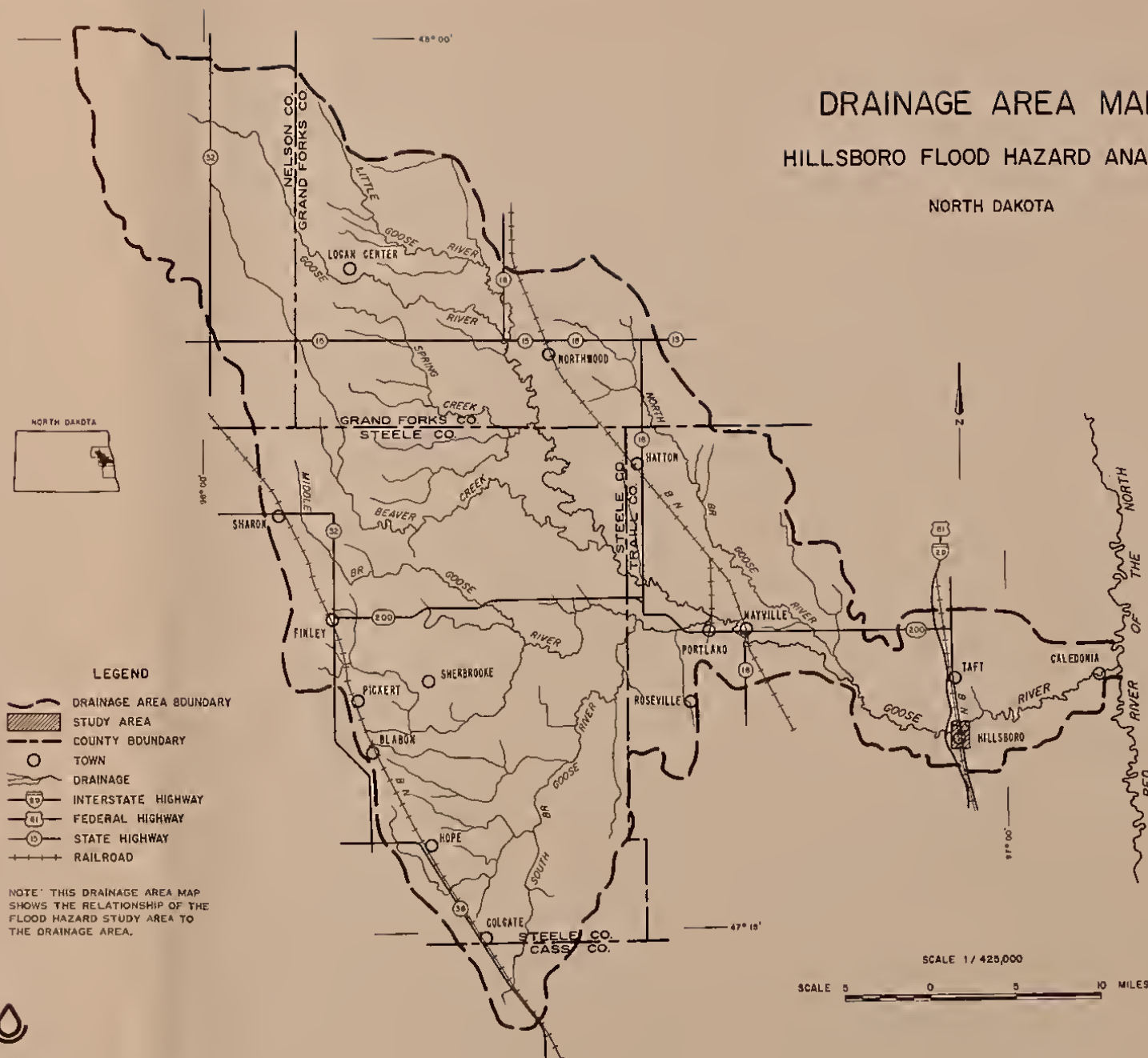
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 Traced _____ Title _____
 Checked _____ Date _____ Drawing No. 5, P-32,091.1



DRAINAGE AREA MAP

HILLSBORO FLOOD HAZARD ANALYSES

NORTH DAKOTA



- LEGEND**
- DRAINAGE AREA BOUNDARY
 - STUDY AREA
 - COUNTY BOUNDARY
 - TOWN
 - DRAINAGE
 - INTERSTATE HIGHWAY
 - FEDERAL HIGHWAY
 - STATE HIGHWAY
 - RAILROAD

NOTE: THIS DRAINAGE AREA MAP SHOWS THE RELATIONSHIP OF THE FLOOD HAZARD STUDY AREA TO THE DRAINAGE AREA.

SOURCE:
USGS 1/250,000 SCALE BASE MAPS,
NORTH DAKOTA COUNTY HIGHWAY MAPS,
AND INFORMATION FROM FIELD TECHNICIANS

TRANSVERSE MERCATOR PROJECTION

SCALE 1/425,000
SCALE 5 0 5 10 MILES

6-7-75
S, P-32,091 5

PLATE 3

R 51 W | R 50 W

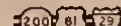
LEGEND



SHEET COVERAGE



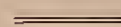
STREAM NETWORK



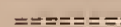
INTERSTATE, FEDERAL, & STATE HIGHWAY



HARD SURFACE ROAD



IMPROVED ROAD



DIRT ROAD



RAILROAD



CORPORATE LIMIT

47° 25' 00"

T
146
NT
145
NCITY OF
HILLSBORO

4

NORTH DAKOTA

SHEET INDEX

HILLSBORO FLOOD HAZARD STUDY AREA
TRAILL COUNTY, NORTH DAKOTA

47° 23' 00"

SCALE 1 / 24,000

SCALE 0 1/4 1/2 1 MILE

POLYCONIC PROJECTION

SOURCE:
ASCS AERIAL PHOTO (1971)
AAA-3MM-84, USGS 7 1/2 MIN.
QUADRANGLE MAP (1963), AND INFORMATION
FROM FIELD TECHNICIANS.

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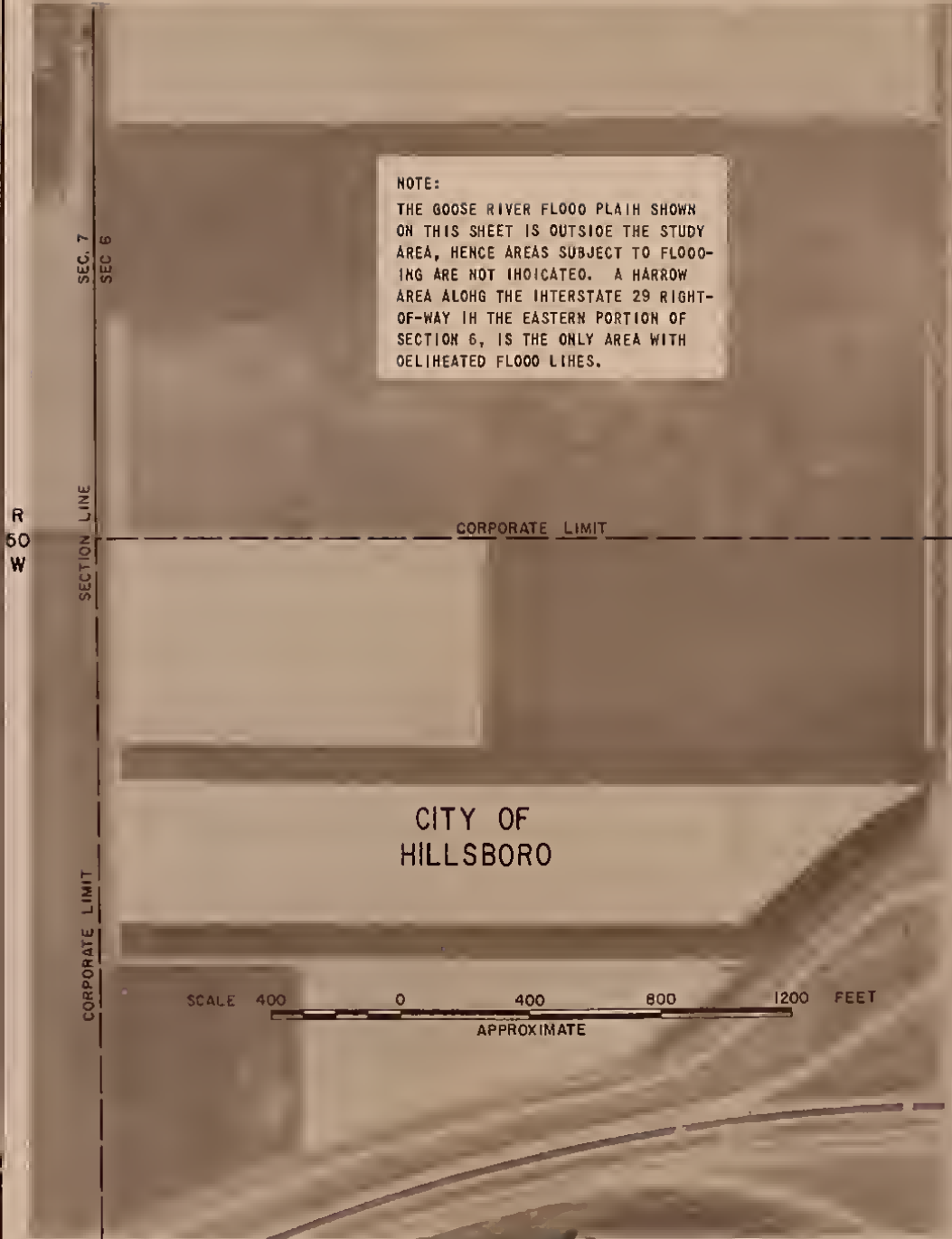
PLATE 4

NOTE:
 THE GOOSE RIVER FLOOD PLAIN SHOWN ON THIS SHEET IS OUTSIDE THE STUDY AREA, HENCE AREAS SUBJECT TO FLOODING ARE NOT INDICATED. A HARROW AREA ALONG THE INTERSTATE 29 RIGHT-OF-WAY IN THE EASTERN PORTION OF SECTION 6, IS THE ONLY AREA WITH DELINEATED FLOOD LINES.

LEGEND

- 500-YEAR FREQUENCY FLOOD
- 100-YEAR FREQUENCY FLOOD
- 50-YEAR FREQUENCY FLOOD
- STREAM CHANNEL

NOTE
 LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND.



U. S. DEPARTMENT OF AGRICULTURE
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HILLSBORO FLOOD HAZARD AREA
 TRAILL COUNTY, NORTH DAKOTA

NOV. 1973 SHEET 1 OF 5 PLATE 5

SOURCE: ASCS AERIAL PHOTO AAA-3NM-64 (1971), AND INFORMATION FROM FIELD TECHNICIANS.

T 145 N

T 146 N

INTERSTATE 29

END OF STUDY

MILE 29.97

CORPORATE LIMIT

7 6
8 5

SECTION LINE

2

R
50
W

SECTION LINE ROAD

CORPORATE LIMIT

LEGEND

- 500-YEAR FREQUENCY FLOOD
- 100-YEAR FREQUENCY FLOOD
- 50-YEAR FREQUENCY FLOOD
- STREAM CHANNEL

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY
FROM ACTUAL LOCATIONS ON THE GROUND

CORPORATE LIMIT

CORPORATE LIMIT

CITY OF
HILLSBORO

BURLINGTON NORTHERN R.R.

SCALE 400

0

400

800

1200 FEET

APPROXIMATE

FOOSMAN DAM

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

HILLSBORO FLOOD HAZARD AREA

TRAILL COUNTY, NORTH DAKOTA

NOV. 1973

SHEET 2 OF 5

PLATE 6

SOURCE: ASCS AERIAL PHOTO AAA-3MM-84 (1971), AND
INFORMATION FROM FIELD TECHNICIANS.

T 145 N T 146 N

LEGEND

- 500-YEAR FREQUENCY FLOOD
- 100-YEAR FREQUENCY FLOOD
- 50-YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- SEC. 8-8 VALLEY SECTION

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY
FROM ACTUAL LOCATIONS ON THE GROUND

SECTION LINE

SCALE 400 0 400 800 1200 FEET
APPROXIMATE

R 50 W

Z

CORPORATE LIMIT

CITY OF HILLSBORO

SEC. 8-8

MILE 28.92

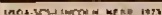
BURLINGTON NORTHERN R.R.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

HILLSBORO FLOOD HAZARD AREA
TRAIL COUNTY, NORTH DAKOTA

NOV. 1973 SHEET 3 OF 5 PLATE 7

SOURCE: ASCS AERIAL PHOTO AAA-3MM-84 (1971), AND
INFORMATION FROM FIELD TECHNICIANS.



LEGEND

- 500-YEAR FREQUENCY FLOOD
- 100-YEAR FREQUENCY FLOOD
- 50-YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- SEC. A-A VALLEY SECTION

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY
FROM ACTUAL LOCATIONS ON THE GROUND.

SCALE 400 0 400 800 1200 FEET
APPROXIMATE

**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

HILLSBORO FLOOD HAZARD AREA
TRAIL COUNTY, NORTH DAKOTA

500-YEAR FREQUENCY FLOOD
100-YEAR FREQUENCY FLOOD
50-YEAR FREQUENCY FLOOD
STREAM CHANNEL

SEC. A-A VALLEY SECTION

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY
FROM ACTUAL LOCATIONS ON THE GROUND.

SCALE 400 0 400 800 1200 FEET
APPROXIMATE

—

SECTION LINE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

HILLSBORO FLOOD HAZARD AREA

TRAILL COUNTY, NORTH DAKOTA

NOV. 1973

SHEET 5 OF 5

PLATE 9

SOURCE: ASCS AERIAL PHOTO AAA-3MM-B4 (1971), AND INFORMATION FROM FIELD TECHNICIANS.



SOIL CONSERVATION SERVICE